CLAIMS

What is claimed is:

1. A method of analyzing uncertainties in a system having at least two modules, comprising:

propagating an uncertainty distribution associated with each of a set of inputs through a module to produce an uncertainty in a set of outputs of said module;

generating a probabilistically equivalent model of said module, said equivalent model producing a model of said outputs; and

providing said model of said outputs in a common data architecture for use as inputs by any other module in said system.

- 2. The method according to claim 1, wherein said probabilistically equivalent model is a deterministically equivalent model.
- 3. The method according to claim 2, wherein said deterministically equivalent model is a reduced-order model.
- 4. The method according to claim 1, wherein said propagating said uncertainty distribution uses a Monte Carlo method.
- 5. The method according to claim 1, wherein at least one of said set of outputs is incorporated into at least one of said set of inputs in a feedback loop.
- 6. A method of analyzing uncertainties in a system, comprising:

substituting at least one of a plurality modules of a system with a corresponding probabilistically equivalent module model, said equivalent module model adapted to propagate uncertainties in inputs of said module to outputs of said module;

providing outputs of each of said modules in a common data architecture for use as inputs by any other module, said architecture adapted to propagate uncertainties in said outputs to said inputs of said other module; and

substituting said plurality of modules with a single probabilistically equivalent system model for propagating uncertainties in system inputs to system outputs.

7. The method according to claim 6, further comprising:

providing an optimization module for optimizing an objective function, said optimization module adapted to receive said system outputs and to vary said system inputs.

- 8. The method according to claim 7, wherein said objective function is a weighted function of two or more output parameters.
- 9. The method according to claim 6, wherein said probabilistically equivalent module model is a deterministically equivalent model.
- 10. The method according to claim 9, wherein said deterministically equivalent model is a reduced-order model.
- 11. The method according to claim 6, wherein said probabilistically equivalent system model is a deterministically equivalent model.
- 12. The method according to claim 11, wherein said deterministically equivalent model is a reduced-order model.
- 13. A system for generating an uncertainty analysis, comprising:

a module adapted to receive a set of inputs and to produce a set of outputs as a function of said inputs, each of said inputs having an associated uncertainty distribution;

means for propagating said uncertainty distribution of said inputs through said module to produce an uncertainty in said outputs;

means for generating a probabilistically equivalent model of said module, said equivalent model producing model outputs; and

means for providing said outputs in a common data architecture for use as inputs by any other module in said system.

- 14. The system according to claim 13, wherein said probabilistically equivalent model is a deterministically equivalent model.
- 15. The system according to claim 14, wherein said deterministically equivalent model is a reduced-order model.
- 16. The system according to claim 14, wherein said means for propagating said uncertainty distribution uses a Monte Carlo method.
- 17. A system of analyzing uncertainties in a system, comprising:

means for generating a probabilistically equivalent module model for at least one of a plurality modules of a system, said equivalent module model being adapted to propagate uncertainties in inputs of said module to outputs of said module;

means for providing outputs of each of said modules in a common data architecture for use as inputs by any other module, said architecture adapted to propagate uncertainties in said outputs to said inputs of said other module; and means for generating a single probabilistically equivalent system model for said

plurality of modules for propagating uncertainties in system inputs to system outputs.

18. The system according to claim 17, further comprising:

an optimization module for optimizing an objective function, said optimization module being adapted to receive said system outputs and to vary said system inputs.

- 19. The system according to claim 18, wherein said objective function is a weighted function of two or more output parameters.
- 20. The system according to claim 17, wherein said probabilistically equivalent module model is a deterministically equivalent model.
- 21. The system according to claim 20, wherein said deterministically equivalent model is a reduced-order model.
- 22. The system according to claim 17, wherein said probabilistically equivalent system model is a deterministically equivalent model.
- 23. The system according to claim 22, wherein said deterministically equivalent model is a reduced-order model.
- 24. A system for generating an uncertainty analysis, comprising:

a modeling module adapted to receive a set of inputs and to produce a set of outputs as a function of said inputs, each of said inputs having an associated uncertainty distribution;

an uncertainty propagation module adapted to propagate said uncertainty distribution of said inputs through said modeling module to produce an uncertainty in

said outputs;

an equivalent model generation module adapted to generate a probabilistically equivalent model of said modeling module, said equivalent model producing said outputs; and

an output generation module adapted to provide said outputs in a common data architecture for use as inputs by any other module.

- 25. The system according to claim 24, wherein said probabilistically equivalent model is a deterministically equivalent model.
- 26. The system according to claim 25, wherein said deterministically equivalent model is a reduced-order model.
- 27. The system according to claim 24, wherein said uncertainty propagation module uses a Monte Carlo method.
- 28. A system of analyzing uncertainties in a system, comprising:

an equivalent model generation module adapted to generate a probabilistically equivalent subsystem model for at least one of a plurality of subsystems, said equivalent subsystem model being adapted to propagate uncertainties in inputs of said subsystem to outputs of said subsystem;

an output generation module adapted to provide outputs of each of said subsystems in a common data architecture for use as inputs by any other subsystem, said architecture being adapted to propagate uncertainties in said outputs to said inputs of said other subsystem; and

an equivalent system generation module adapted to generate a single probabilistically equivalent system model for said plurality of subsystems for

propagating uncertainties in system inputs to system outputs.

- 29. The system according to claim 28, further comprising:
 - an optimization module for optimizing an objective function, said optimization module being adapted to receive said system outputs and to vary said system inputs.
- 30. The system according to claim 29, wherein said objective function is a weighted function of two or more output parameters.
- 31. The system according to claim 28, wherein said probabilistically equivalent subsystem model is a deterministically equivalent model.
- 32. The system according to claim 31, wherein said deterministically equivalent model is a reduced-order model.
- 33. The system according to claim 28, wherein said probabilistically equivalent system model is a deterministically equivalent model.
- 34. The system according to claim 33, wherein said deterministically equivalent model is a reduced-order model.
- 35. A program product, comprising machine readable program code for causing a machine to perform following method steps:

propagating an uncertainty distribution associated with each of a set of inputs through a module to produce an uncertainty in a set of outputs of said module;

generating a probabilistically equivalent model of said module, said equivalent model producing a model of said outputs; and

providing said model of said outputs in a common data architecture for use as inputs by any other module in said system.

- 36. The program product according to claim 35, wherein said probabilistically equivalent model is a deterministically equivalent model.
- 37. The program product according to claim 36, wherein said deterministically equivalent model is a reduced-order model.
- 38. The program product according to claim 35, wherein said propagating said uncertainty distribution uses a Monte Carlo method.
- 39. A program product, comprising machine readable program code for causing a machine to perform following method steps, comprising:

substituting at least one of a plurality modules of a system with a corresponding probabilistically equivalent module model, said equivalent module model adapted to propagate uncertainties in inputs of said module to outputs of said module;

providing outputs of each of said modules in a common data architecture for use as inputs by any other module, said architecture adapted to propagate uncertainties in said outputs to said inputs of said other module; and

substituting said plurality of modules with a single probabilistically equivalent system model for propagating uncertainties in system inputs to system outputs.

40. The program product according to claim 39, wherein said program code causes a machine to further perform the following method step, further comprising:

providing an optimization module for optimizing an objective function, said optimization module adapted to receive said system outputs and to vary said system

inputs.

- 41. The program product according to claim 40, wherein said objective function is a weighted function of two or more output parameters.
- 42. The program product according to claim 39, wherein said probabilistically equivalent module model is a deterministically equivalent model.
- 43. The program product according to claim 42, wherein said deterministically equivalent model is a reduced-order model.
- 44. The program product according to claim 39, wherein said probabilistically equivalent system model is a deterministically equivalent model.
- 45. The program product according to claim 44, wherein said deterministically equivalent model is a reduced-order model.